THE DEVELOPMENT AND IMPLEMENTATION OF VIRTUAL REALITY FOR TRAINING IN THE FUTURE

ARTICLE

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There is an expectation by society that law enforcement personnel respond correctly to critical incidents. Police officers depend upon the skill level they have obtained through training to make good decisions. Computer science advancements have developed reality-based training that can provide a realistic training environment. This computer technology is virtual reality (VR) which provides simulated training environments that are realistic to what the officer will experience in the street. Virtual reality enables the officer to experience realistic verifiable training while in a protected training environment.

History

Computer-generated virtual reality started in the early 1960's with engineers developing digital information for graphical displays for computer screens. In the late 1960's and early 1970's, aerospace engineers utilized the advancements in virtual reality to create simulated environments where pilots and astronauts could train while safely on the ground. The 1980's brought high-speed processors capable of sophisticated graphics. The production of the CD-ROM took place in the 1990's. This mass-storage medium further developed virtual reality.[1]

Defining Virtual Reality

Virtual reality is a three-dimensional, computer generated simulation in which one can navigate, interact and be immersed in an artificial environment. Virtual is derived from the concept of "virtual memory" in a computer, which acts as an actual memory. Human beings respond well to three-dimensional images

which allows us to interface with VR technology so that we can experience the virtual environments in real time.[2]

Other advancements included the data glove: a glove wired with sensors and connected to a computer system for gesture recognition. It is used for tactile feedback and enables navigation through virtual environment and interaction with 3-D products. Head Mounted Display (HMD) units utilize a set of goggles or a helmet with tiny monitors in front of each eye to generate images seen by the viewer as being three-dimensional. Other advancements included spherical projection systems and experiential, multi-user environments known as the CAVE. CAVE is virtual reality using a projection device that uses walls and the ceiling to give the illusion of immersion.[3]

Scientific Advancements in Virtual Reality

Interactions between humans and computer technology can occur by the use of different VR modes. Virtual reality consists of the following eight modes: subjective immersion, desktop VR, projected VR, spatial immersion, immersive VR, CAVE, telepresence and augmented.

Subjective immersion refers to the user viewing the scenario from a remote position. Interaction with the scenario is performed via computer monitors, keyboards, mouse controls and other computer hardware as needed. Simulation software provides three-dimensional displays. Desktop VR is the most commonly utilized mode for virtual reality. It is applied in games and CAD/CAM interactions, for example a CD-ROM bomb threat-training simulator. Projected VR simply consists of an image of the real user overlapped onto a

computer-generated environment or situation. A tracking device details the use's actions and inserts them into the virtual environment to simulate actions and reactions.

A more complex form of VR is spatial immersion. This process allows the user to interact with the simulated environment and feel the accompanying sensations. Special equipment is required for this process. The user must wear special equipment to permit the perception of existing objects and events as they occur in relation to the user's movement. Spatial immersion is best utilized where the explorations of spaces and objects within those spaces are the goal. Immersive VR takes the immersion to a deeper level. The user must wear a head-mounted display to facilitate correspondence of user's movements and environmental feedback. CAVE virtual reality is a small room where multiple users can share the experience from different angles via the projection of a computer-generated world onto the walls. Telepresence utilizes robotic and electronic sensors controlled by the user in a remote location. An example of this is space or deep-sea exploration. Augmented VR is virtual reality enriched with virtual objects and items, and is best suited for abstractions like database navigation or science fiction.[4]

According to Dr. Annette Sobel, a principal member of the technical staff at Sandia National Laboratory in Albuquerque, New Mexico, review of incidents occurring on a worldwide scale reveals change in the nature of incidents to which law enforcement personnel are responding. Law enforcement agencies in the United States are recurrently exposed to critical incidents such as hostage

situations and terrorism, and are likely to be exposed to bio-chemical situations in the future. Dr. Sobel believes advancements in technology, such as Virtual Reality (VR), provide law enforcement with an opportunity to train for such incidents in a controlled and safe environment.[5]

VR Technology Specific to VRaptor

Another technology advancement in the area of virtual reality is VRaptor (Virtual Reality Assault Planning, Training, or Rehearsal.) Dr. Sharon Stansfield, a senior member of the technical staff at Sandia National Laboratories, developed this technology. Dr. Stansfield has a Ph.D. In Computer Science and has focused her research toward machine intelligence, cognitive models of robotic perception, and medical image interpretation. VRaptor is a software program that is capable of being operated on a standard personal computer with additional virtual reality hardware, enabling trainees to work individually or as a team to experience training exercises.[6]

VRaptor technology specific to the VRaptor system is a component of immersive VR. VRaptor involves a type of immersive display system that enables an individual to experience computer-generated environments through visual, auditory, and tactile inputs.[7] The Head Mounted Display (HMD) is a helmet-like device containing a screen that displays a computer-generated visual scene and uses headphones for the audio effects. The HMD has a tracking system that interacts with the computer so the system can respond to the user's actions, i.e., looking down or to the right, and alters the visual scene of the user based on this interaction. Other technological advances incorporate a sense of

touch or haptic interfacing to enable the computer system to generate feedback from the environment the trainee is experiencing. [8]

Training Benefits Involving Virtual Reality

An advantage of VR technology in comparison to multi-media simulation systems is the ability of the trainee to interact with training environments. This form of training is exceptional for many reasons. Its immersive quality allows trainees to encounter the sensations of sight, sound, and touch. Because it is interactive actions have immediate reactions and consequences, including virtual death of the trainee. Virtual reality customizes team training via programming by an instructor who can vary roles, moves, and placement of VR characters. Also, the comparatively small package allows for movement to onsite crisis locations for realistic simulation training prior to actual action. Finally, VRaptor can replicate hazardous situations for the development of tactical team skills and individual judgement in a safe manner.[9]

Law enforcement officers currently receive the majority of their critical incident training through scenario exercises. Though these exercises are helpful, they are not capable of creating real life situations, such as officer involved shootings, or measuring the officer's reaction time to a potential hazardous situation. In many small agencies the occurrences of these crises are too infrequent to maintain acceptable levels of skill, judgement, and preparedness. Future projections of increased terrorist activity, violent crime, and biochemical warfare illustrate the need for improved training. Crisis simulations and

immersion by virtual reality provide an excellent training resource for officers of agencies of all sizes.

Training Cost

Small law enforcement organizations continually work with budget restraints and must plan in advance for equipment purchases. A potential means of making this training available to smaller organizations would be the development of regional training locations.

Research indicates that VR simulators reduce implementation of training time by 30 percent. In addition, this would reduce the amount of overtime needed to replace the officer who is at training. Other cost-saving considerations include:

1. Negative publicity due to a mishandled crisis situation.
2. The impact of citizens and police officers hurt or killed because of poor decisions.
3. Poor outcomes could result in budget reductions and organizational shake-ups.[10]

Applying technological advancements as a training tool could reduce our liability by better preparing law enforcement officers.

Equipment Costs

Virtual reality systems are intensive and complex computer sources. In order to create photographic realism, the computer must be capable of generating an image comprised of 800 million polygons per second. High-end systems capable of producing 2 million polygons/second cost several thousand

of dollars. A Head Mounted Display (HMD) costs 10,000 to 15,000 dollars depending on the complexity of the head mount.[11] Other hardware costs depend on the complexity of the individual system, ranging anywhere from 100,000 to 250,000 dollars. Market projects for the VRaptor indicate that in the first three years, over 550 units could be sold at 150 thousand dollars per unit. Target markets will be federal agencies, military, state and local police, prisons, and exposure to the international market.[11]

Potential Funding Sources

There are several possible sources for virtual reality equipment funding. Federal grants and sponsorships from interested private sector industries are two potential sources. Insurance companies interested in reducing potential payouts may choose to fund VR programs. Military services that use VR training may form partnerships with local law enforcement agencies so they can experience VR training.

Side Effects

Virtual reality technology is in its infancy and the amount of data regarding side effects is limited. Both physical and psychological effects have been identified. Between 10 and 60 percent of individuals who use VR systems experience cybersickness. Symptoms include headache, blurred vision, dizziness, and mild to severe nausea. Cybersickness may be the result of confused and conflicting sensory inputs.[12] Psychological effects have been described as sopite syndrome. This occurs when the individual has been exposed to the VR environment for an extended period of time. Symptoms

include chronic fatigue, lack of initiative, drowsiness, lethargy, apathy, and irritability.[13] Another possible psychological reaction an individual could experience is anxiety from wearing VR helmets and feeling claustrophobic.[14]

Officer training utilizing VR can reduce human and material loss during critical events. Officers with infrequent exposure to these situations can rehearse and practice appropriate responses in a safe but effective setting. An additional benefit to VR training is improved citizen relations from fewer judgmental errors by officers, resulting in injuries or loss of life.

Defining the Future

This strategic plan will define strategies important to developing, managing, and implementing virtual reality training for officers in a small law enforcement agency by the year 2005. To enhance focus, a vision was created to describe the future. The vision defines where we want to be in the next three to ten years.[15]

This strategic plan will define strategies important to law enforcement staying current in an environment of constant influx. A vision was created to describe the future. The vision allows members of the organization to look forward from where they are to where they want to be.

Organizational Analysis

In preparing for the implementation and/or organizational change, there are key facets that need to be analyzed. This can be accomplished by gaining an understanding of our organizations internal workings, and matching the internal Strengths and Weaknesses with environmental Opportunities and

Threats. SWOT analysis is a systematic means to identify strengths and weaknesses involving the implementation of virtual reality into a small law enforcement agency.[16]

Stakeholder Identification

The identification of stakeholders and an analysis of their specific concerns and expectations are critical to the strategic planning process. A stakeholder is defined as individuals or groups that are impacted by what we do and individuals or groups who can impact what we do. It is believed that the state of an organization, at a given point in time, is the result of the interactions with and among stakeholders.[17]

City Council

- Want to minimize costs associated with training
- Leadership philosophy may change after elections
- If training/technology is too controversial council may not support. However, if it is positive they will support

City Attorney / Risk Manager

- Depending on court rulings, this technology may or may not be supported
- If this training assists the city in liability cases it will be supported and encouraged

City Manager

- Will be concerned about council and community reactions
- Will want technological training if proven to lower the amount of money paid out against cities for cases involving questionable decisions made by police officers
- Will want to be assured there will not be any hidden expenses
- Will want to know if the city is expected to fund any part of the training

Chief of Police / Police Management

- Want competent people
- Want police personnel to be able to train for infrequent events so they react/plan correctly
- Will want policy/procedures for training
- Want to protect officers and city from exposure to liability
- Will be concerned as to what the City Council, City Manager, and the community think of the training tool
- Will keep the pulse on what is occurring throughout the state regarding the training topic to ensure there are not unforeseeable developments
- Will want to know what value officers place on the training
- Will want to know the budgetary plan, i.e., federal and state governments

Trainers / Supervisors

- Want realistic, verifiable training
- Want to develop competent people
- Supervisors would find the technology helpful for practicing infield supervision of calls in progress

Police Unions

- Will be watching court rulings involving Virtual Reality training
- Will be concerned if there are physical side effects as a result of training
- Will instructors be chosen from individual agencies, i.e., available overtime

Peace Officer Standards and Training (POST)

- POST will be dependent on funding, i.e., federal government/Department of Defense and/or State of California
- Will be concerned about setting up a statewide program to ensure all officers receive training whether they are affiliated with a small or large law enforcement agency
- They will be monitoring legal cases as they develop throughout the state

Police Officers

- Will support training if they view it as valuable
- Will want technology to be realistic, not arcade-like

- If they value training they will want regular scheduled training
- Will want POST to support and help acceptance of training
- If there are officers who are not able to go through training due to a physical condition they want other training available to cover the same training topics

Developers of Virtual Reality Technology

- Will want to know there is a market for their product
- Will want assurance from government they will be financially committed

Development of Alternative Strategies

As part of the strategic plan, leaders need to educate stakeholders. This educational process will assist in the development and implementation of alternative strategies. Below are three possible strategies, which could assist in the development and implementation of virtual reality as a training tool.

Strategy 1 City government officials / Chiefs of Police need to empower themselves through legislative means.

This strategy involves working through such entities as Cal Chiefs, League of California Cities, POST, legal advisors, risk managers, and the Attorney General's office so they can educate and communicate the value of investing in the training needs of police officers and the many diverse situations they face.

Strategy 2 An in-depth educational process needs to be designed / outlined for all stakeholders.

This strategy allows law enforcement an opportunity to emphasize the type of image they want projected involving virtual reality and training. This can help stakeholders see value in the technology and how law enforcement officials are planning for the future. Another positive aspect of this is by planning an

education / marketing strategy it can help formalize the impact on stakeholders simultaneously.

Strategy 3 Scientific developers of VR technology need to work with risk managers and focus on training areas where financial liability issues have been identified, as well as with POST and personnel involved with training.

The Northern California Cities Self Insurance Fund (NCCSIF) is an insurance company which represents 20 small cities, covering liability issues and suits involving decisions by law enforcement personnel. Between 1994 – 1999, NCCSIF paid out nearly 4 million dollars. The areas of greatest pay out were vehicle collisions, pursuits, civil rights violations, excessive force, and false arrests.[17]

Law enforcement organizations have experienced significant changes over the past century. Achieving a successful, inclusive organization in the future depends on the vision created by our leaders today. New styles of leadership, thinking, communication, problem-solving, and strategic planning will be critical to success.

Increasing incidences of severe crises necessitates law enforcement develop improved means of training for personnel to handle these situations while minimizing human and material loss. Current training methods fail to keep law enforcement personnel in small agencies adequately trained and prepared to handle critical incidents. Virtual reality offers a cost-effective and thorough means of accomplishing this training. Leaders of these agencies must facilitate and engage change to maintain their effectiveness into the future.

Conclusions

At one time, computer technology was an event. Now it is a trend. Computer technology will continue to become a greater part of our organizational operations and training. Leaders of our profession need to continue to look toward the possible events within technological advancements to make informed decisions. Technological advancements in the field of virtual reality will be a beneficial training and planning tool for future events that have not yet occurred, for example, by taking a panoramic view of issues around the world such as bio-chemical warfare. The question should be formulating: It is not if this event will occur, but rather when?

Development of virtual reality exercises specific to the training needs of law enforcement will enhance the likelihood of critical situations being handled appropriately. By implementing this type of training by the year 2005 individuals who are currently involved in the profession will have another educational means of preparation. For those individuals who will be entering the law enforcement workforce in the year 2005, they potentially will benefit by experiencing virtual reality during academy training. This will enhance their ability to correctly respond to potentially dangerous situations without the formation of bad habits. One concern law enforcement recruiters have is that those individuals currently being recruited have little life experience and may have difficulty responding to hostile situations. Virtual reality will afford academy trainees an opportunity to experience such training in a protected environment.

Implementation of VR training by POST officials at regional training locations will enable police officers from both small and large law enforcement agencies to experience this educational process. The potential of this technology as a training tool is limited only by ones imagination. Advancements in the field of virtual reality will enhance educational opportunities for law enforcement personnel so the profession can keep pace with its ever-changing response to society demands.

Endnotes

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